the ENERGY lab

PROJECT FACTS

Fuels

Demonstration of a Piston Driven Plug Feed System for Feeding Coal/Biomass Mixtures across a Pressure Gradient for Application to Commercial CBTL Systems

Background

According to the U.S. Department of Energy (DOE) Annual Energy Outlook 2011 Early Release Overview, U.S. dependence on imported liquid fuels measured as a share of total U.S. liquid fuel use was 52 percent in 2009. In an effort to increase the nation's energy security, the DOE is funding research and development (R&D) of energy technologies that use domestic sources of energy. The U.S. has access to large amounts of coal and biomass, which can be gasified to co-produce power, fuels, chemicals, and hydrogen.

The incorporation of biomass feedstocks into large scale coal gasification and liquids production processes partially mitigates carbon dioxide (CO_2) emission impacts associated with the production of coal-derived liquid fuels. With CO_2 sequestration, coal/biomass to liquids (CBTL) processes may even be carbon negative. Previous studies have demonstrated the ability to co-gasify biomass in entrained flow (EF) gasifiers, the dominant technology for large scale gasification and future CBTL systems. However, several challenges related to biomass utilization have been observed. A primary challenge related to biomass utilization in large scale commercial CBTL is the ability to reliably feed a variety of biomass feedstocks to the gasifier as biomass-coal mixtures.

The National Energy Technology Laboratory (NETL) is partnering with the Southern Research Institute (SRI) to develop and demonstrate a piston driven plug feed system for feeding coal and biomass mixtures across a pressure gradient for application to commercial CBTL systems.

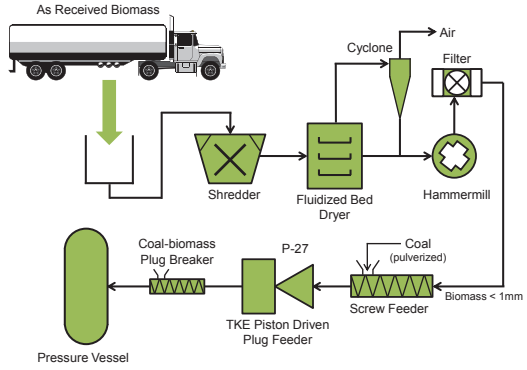

Figure 1: Process Flow for biomass to be pressurized for use in Coal/Biomass to Liquids process

CONTACTS

Arthur L. Baldwin
Project Manager
National Energy Technology Laboratory
626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236-0940
(412) 386-6011
arthur.baldwin@netl.doe.gov

Santosh Gangwal
Principal Investigator
Southern Research Institute
2000 Ninth Avenue South
P.O. Box 55305
Birmingham, AL 35205-2708
(919) 282-1053
gangwal@southernresearch.org

Daniel Driscoll
Hydrogen and Syngas Technology Manager
National Energy Technology Laboratory
3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507-0880
(304) 285-4717
daniel.driscoll@netl.doe.gov

PARTNERS

TK Energi A/S

PROJECT DURATION

Start Date
10/01/2008

End Date
06/30/2011

COST

Total Project Value
$ 1,625,329

DOE/Non-DOE Share
$ 1,053,894 / $ 571,435

NATIONAL ENERGY TECHNOLOGY LABORATORY

Albany, OR • Fairbanks, AK • Morgantown, WV • Pittsburgh, PA • Sugar Land, TX

Website: www.netl.doe.gov

Customer Service: 1-800-553-7681

U.S. DEPARTMENT OF ENERGY

Project Description

SRI and its partner, TK Energi A/S of Denmark, have identified an approach to feeding coal/biomass blends that utilizes a proven, existing biomass feed system that can be used to feed coal/biomass mixtures at high operating pressures similar to that encountered in Entrained Flow (EF) gasifiers. The feed system has been successfully tested at small scale and high operating pressures in EF and other types of gasifiers.

Figure 2: Piston driven plug feed system

In this project, a pilot-scale piston driven plug feed system will be used to feed biomass/coal mixtures into a pressurized environment and demonstrated over a range of three types of coal (lignite, bituminous, and sub-bituminous) and three classes of biomass feedstocks (woody biomass, grasses, and corn stover). An appropriate pretreatment system for production of feeds of the particle size and specifications required for EF gasification will be utilized during this project to prepare the biomass. At the conclusion of the demonstration, SRI will perform preliminary engineering scale-up and economic analyses of the feed system for commercial CBTL processes to allow for evaluation of CBTL process economics. TK Energi will provide the plug-based feeding system for the project as well as technical guidance throughout.

Goals and Objectives

The overall goal of this project is to design and demonstrate a biomass pretreatment system and a coal/biomass co-feed system for the high pressure, commercial EF gasifiers over a range of different feedstocks that are likely candidates to be used in future large-scale CBTL facilities. Specific objectives include (1) specifying an appropriate biomass pretreatment process, (2) demonstrating the ability of an existing feed system design to feed a variety of biomass and coal mixtures into a high-pressure environment, and (3) evaluating the engineering and economic viability of the proposed feed system for large-scale CBTL processes.

Accomplishments

SRI initially commissioned the coal-biomass piston plug feeder to run at atmospheric pressure. The piston-plug feeder was run at 1200-2000 pounds-force per square inch (psi) hydraulic pressure to form a series of plugs using a 50:50 coal-wood mixture containing about four percent moisture. The plugs formed at 1600 psi or higher pressure indicated sufficient integrity to withstand a gas back-pressure of 600 psi or even higher. Following the atmospheric pressure runs, coal-biomass mixtures consisting of 50 to 70 percent bituminous coal and lignite with wood, corn stover, and switch grass were prepared. The feeder was then demonstrated for feeding these mixtures into a high pressure tank at 350-450 pounds-force per square inch gauge (psig) at variable feed rates from 25 to 220 lb/h.

Figure 3: Sample of pressurized coal/biomass

Benefits

This project will provide fossil fuel plants with a technically viable and efficient biomass/coal feed system for use in a high-pressure environment that will facilitate the use of different feedstocks of both coal and biomass types. The implementation of such technology will potentially allow gasification systems and CBTL facilities to operate in a more environmentally sound manner.